CLAIMS

1. A high voltage rotating electric machine comprising a stator (6), a rotor (7) and at least one winding (1) wound on the stator having inner electrically conducting means (3) and surrounding electrical insulation (4), characterised in that said electrically conducting means comprises conductor means (32) and cooling means (31) for cooling the conductor means (32) to improve the electrical conductivity of the conductor means, and in that said electrical insulation (4) is solid and comprises spaced apart inner and outer layers (35, 36) each having semiconducting properties and, between said inner and outer layers, an intermediate layer (37) of electrically insulating material.

2. An electric machine according to claim 1, characterised in that the said semiconducting inner layer (35) is electrically connected to, so as to be at substantially the same electric potential as, the conductor means (32).

3. An electric machine according to claim 1 or 2, characterised in that the said semiconducting outer layer (36) is connected to a controlled electric potential along its length.

4. An electric machine according to claim 3, characterised in that the said semiconducting outer layer (36) is connected to said controlled electric potential at spaced apart regions along the length of the outer layer.

5. An electric machine according to claim 3 or 4, characterised in that the said controlled electric potential is earth potential.

6. An electric machine according to claim 5, characterised in that, with connection of the semiconducting outer layer (36) to earth potential, the electric field of

the machine both in winding slots (10) and in end winding regions will be near zero.

7. An electric machine according to claim 3 or 4, characterised in that the electric machine has more than one winding wound on the stator and in that a separate controlled potential is selected for each winding.

8. An electric machine according to any one of the preceding claims, characterised in that at least one of said semiconducting inner and outer layers (35, 36) has substantially the same coefficient of thermal expansion (α) as that of the said insulating layer (37).

9. An electric machine according to any one of the preceding claims, characterised in that each pair of adjacent layers (35-37) of said electrical insulation are secured to each other along substantially their entire contact surfaces.

10. An electric machine according to any one of the preceding claims, characterised in that the or each winding is in the form of a cable (1).

11. An electric machine according to any one of the preceding claims, characterised in that the said conductor means (32) comprises superconducting means.

12. An electric machine according to claim 11, characterised in that the cooling means comprises central tubular support means (31) for conveying cryogenic coolant fluid, e.g. liquid nitrogen, and in that the superconducting means (32) is of elongate form and is wound around the tubular support means.

13. An electric machine according to claim 11 or 12, characterised in that the said superconducting means comprises high-transition temperature superconducting (or HTS) material.

14. An electric machine accordi
dependent on claim 12, characterised
material comprises HTS tape or wire wo
tubular support means (31)

15. An electric machine according to any o
preceding claims, characterised in that thermal expansi
means (34) are provided between the said electrically
conducting means (3) and the said surrounding electrical
insulation (34).

16. An electric machine according to claim 15,
characterised in that said thermal expansion means comprises
an expansion gap (34).

17. An electric machine according to claim 16,
characterised in that the expansion gap (34) comprises a
void space.

18. An electric machine according to claim 16,
characterised in that the expansion gap (34) is filled with
compressible material, e.g. foamed plastics material.

19. An electric machine according to claim 18,
characterised in that the said compressible material
includes electrically conductive or semiconductive material.

20. An electric machine according to any one of the
preceding claims, characterised in that thermally insulating
means is provided outwardly of the conducting means.

21. An electric machine according to any one of the
preceding claims, characterised in that the or each winding
is wound in stator slots (10) formed in the stator, and in
that each stator slot (10) comprises a number of
substantially circular cylindrical openings (12) extending
axially and radially outside one another, each pair of
adjacent openings (12) being joined by a narrower waist
portion (13).

ıg to claim 13 when

22. An electric machine accordin in that the HTS characterised in that the radii of the said ound around said each stator slot decrease in a direction towa (7).

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23. An electric machine according to any of tion preceding claims, characterised in that the rotating electric machine is connectable to one or more system voltage levels.

24. An electric machine according to claim 23, characterised in that one winding is provided with separate tappings for connection to different system voltage levels.

25. An electric machine according to claim 23 or 24, characterised in that a separate winding is provided for connection to each system voltage level.

26. An electric machine according to any one of the preceding claims, characterised in that the said intermediate layer (37) is in close mechanical contact with each of said inner and outer layers (35, 36).

27. An electric machine according to any one of claims 1 to 25, characterised in that the said intermediate layer (37) is joined to each of said inner and outer layers (35, 36).

28. An electric machine according to claim 27, characterised in that the strength of the adhesion between the said intermediate layer (37) and each of the semiconducting inner and outer layers (35, 36) is of the same order of magnitude as the intrinsic strength of the material of the intermediate layer.

29. An electric machine according to claim 26 or 28, characterised in that the said layers (35-37) are joined together by extrusion.

30. An electric machine according to claim 29, characterised in that the inner and outer layers (35, 36) of semiconducting material and the insulating intermediate layer (37) are applied together over the conducting means (3) through a multi layer extrusion die.

31. An electric machine according to any one of the preceding claims, characterised in that said inner layer (35) comprises a first plastics material having first electrically conductive particles dispersed therein, said outer layer (36) comprises a second plastics material having second electrically conductive particles dispersed therein, and said intermediate layer (37) comprises a third plastics material.

32. An electric machine according to claim 31, characterised in that each of said first, second and third plastics materials comprises an ethylene butyl acrylate copolymer rubber, an ethylene-propylene-diene monomer rubber (EPDM), an ethylene-propylene copolymer rubber (EPR), LDPE, HDPE, PP, PB, PMP, XLPE, EPR or silicone rubber.

33. An electric machine according to claim 31 or 32, characterised in that said first, second and third plastics materials have at least substantially the same coefficients of thermal expansion.

34. An electric machine according to claim 31, 32 or 33, characterised in that said first, second and third plastics materials are the same material.

35. An electric machine according to any one of the preceding claims, characterised in that it is designed for use at high voltages, suitably in excess of 10 kV, in particular in excess of 36 kV, and preferably more than 72.5 kV up to very high transmission voltages, such as 400 kV to 800 kV or higher.

36. An electric machine according to any one of the preceding claims, characterised in that it is designed for use at a power range in excess of 0.5 MVA, preferably in excess of 30 MVA and up to 1000 MVA.

37. Use of a rotating electric machine according to any one of the preceding claims, characterised in that the machine can be operated with up to 100% overload for a period of time exceeding 15 minutes and up to about two hours.

38. Use of a rotating electric machine according to any one of claims 1 to 36, characterised in that the rotating electric machine is directly connected to a power network via connecting devices and without an intermediate transformer between the machine and the network.

39. Use of a rotating electric machine according to any one of claims 1 to 36, characterised in that voltage regulation of the rotating electric machine is performed by control of the magnetic field flow through the rotor.

40. Use of a rotating electric machine according to any one of claims 1 to 36, characterised in that the machine can be operated without mechanical load and that the machine is provided for compensation of inductive or capacitive load on the network.

add A'